Color Management In Cosmetics Packaging

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Keywords: color management, packaging, delta-E

Abstract

This research will test the color management and accuracy of lipstick packaging. This research is specifically targeted at drugstore brand products that typically cannot be tested by the consumer before purchasing. In purchasing makeup, we all want the perfect color for a reasonable price. At stores like Sephora, you can try countless shades of foundations, lipsticks and eye shadows before choosing ones that suit you perfectly. However, this luxury comes at a much higher price. Lower end products sold at drugstores usually cannot be tested before purchasing. This means that for consumers of lower-end products, there is not always a guarantee that a product will work for them. More often than not, the foundation does not match their skin tone, the lipstick is not the color advertised and the eye shadow is not as pigmented as they thought. This can be very frustrating for consumers on a budget who cannot afford to purchase several different shades of one product in order to find the right color. In fact, 32% of global consumers feel that personal care manufacturers do not understand their needs, according to PR Newswire. This also affects manufacturing companies; because if the makeup gets returned, it cannot be resold if it has been used. This ultimately creates waste, as well as a bad brand reputation. Even if consumers do not return lipsticks that failed expectations they are still unsatisfied with the product and may be less likely to purchase from that brand again.

A large aspect of this problem, specifically with lipsticks, is that printers typically cannot reproduce the same vibrancy of color that the lipstick provides. Moreover, many of the brighter red shades are out of gamut for the printer. By testing the color accuracy of lipstick packaging against the product, this research will determine what percentage of colors are outside of the printable gamut, and how this problem can be remedied with different printing techniques.

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Audience for the Project

The audience for this project is manufacturers and packagers. This research calls to the manufacturers of lipstick packaging to pay more attention to the color accuracy of their products. By producing more accurate product, I predict that there will be a decrease in the number of lipsticks returned and an increase in customer satisfaction and loyalty to the brand. Ultimately, this research will determine whether there are any trends in the color inaccuracy of the packaging, how inaccurate the printed colors are on average compared to the actual lipstick, and explore other printing possibilities to create more accurate labels.

Significance

The purpose behind this study is to finds a way to make cosmetic packaging more accurate and personalized in order to help manufacturers produce a more reliable and accurate product for their customers. If this research yields successful results and finds a better way to reproduce a larger percentage of lipstick shades, it will be applicable to many brands and manufacturers. In addition to decreasing the rate of returns, increased color accuracy will increase customer satisfaction and loyalty.
This project combines color management, package design, and cosmetics. The paper itself will provide insight into the package design of cosmetics companies and give an outlook on the market to see which companies produce the most accurate prints, how packages are currently printed, and uncover patterns in reproducing certain colors.

Cosmetic Packaging Background

Drugstore makeup consumers do not get the same experience as high-end makeup consumers. “Women approach some cosmetic products skeptically, like lipstick. Women only buy lipstick after sampling it to judge its desirability” (Marketing News Weekly, 2013). If the customer cannot sample the product, however, the decision will have to be based primarily by the packaging and brand perception. If the packaging is not accurate, the customer will be dissatisfied with the product and the chance of the product being returned will increase, as well as decreasing the likelihood of brand repurchase.

The population for this study will be different drugstore brands of lipstick. A range of colors will be selected and tested for color accuracy against the packaging to determine how accurate the package is and whether there are any patterns in which shades tend to be less accurate. Many lipstick packages have a reputation of lacking color accuracy, which can make consumers more skeptical to purchase the product without being able to test it. Research has shown that there is little difference in ingredients between expensive and cheap makeup. In fact, the difference in price lies in packaging, marketing, celebrity endorsement, and the idea that “cosmetics

consumers actually believe 'more expensive' means 'better'" (Anneli, 2010). Perhaps the high-end makeup is better quality than the drugstore version, but not always. A lot of the time, consumers can find products of very comparable quality for a much cheaper price. The trouble lies in selecting the correct one that will work for the consumer. When the brand has a reputation for having inaccurate label colors, consumers are likely to be hesitant when purchasing an unfamiliar color.

Color Management vs Brand Color Management

Color management is of extreme importance in reproducing brand colors. Jean-Marie Hershey notes that "In these instances, the use of process color is often limited to images, while branding elements are reproduced with special match colors to…achieve more consistent reproduction". This philosophy should also be applied to lipstick packaging. The color swatch should be reproduced using special match colors in order to achieve the most consistent and accurate color reproduction. Additionally, the printing process used to create the packaging is also crucial to accurate color reproduction. Whether the label is printed using spot or process colors can have a great affect on the accuracy of the color produced.
On the subject of printing brand colors with different printing processes Hershey states:

> It's all about the gamut of each device and the reproduction of CMYK in flexo, as opposed to CMYK in gravure and CMYK in offset. If brand colors are reproduced in CMYK rather than as spot colors, management of the process is critical to assure that it matches within tolerances. If a brand color is reprinted using different printing technologies, it is important to re-separate the colors every time using color profiles of the actual inks on the actual substrates for each printing process. With different substrates, you have to match the entire process to take everything into consideration. (2009)

When accurate color matching is crucial, management of the process becomes even more important. Moreover, when using process colors, it can be difficult to achieve a consistently perfect match; meanwhile, using spot colors can be too expensive,

especially when a brand has to create a spot color for every shade of lipstick they sell. Instead, it would be more effective to combine these two and use a combination of CMYK as well as a spot red to create more vibrant colors and expand the printable gamut.

Effects of Better Color Management

Increased color accuracy of lipstick packaging will be beneficial for both manufacturers and consumers. Manufacturers will be able to produce a more accurate package, which will decrease the number of products returned, increase

customer satisfaction, and increase customer loyalty to the brand. The brand will gain a reputation of creating accurately representative packaging, which in turn will make the buying experience more effective and efficient for the customer. If the consumers trust the color they see on the package is the same color as the product, they will be more likely to purchase from the same brand in the future.

Introduction

This study looked into creating a more accurate way to recreate colors for lipstick packaging. By testing a variety of shades between different brands of drugstore lipsticks, this study aimed to find the downfalls of reproducing certain colors. Purchasing makeup at a drugstore can often be frustrating as the color portrayed on the packaging is often inaccurate to the actual color of the product. The objectives of the project were to:

- Test the color accuracy of lipstick packaging to the actual product.
- Determine how different, on average, the advertised color is from the actual color (ΔE)
- Determine whether there is a pattern for which lipstick shades are outside the printable gamut given current manufacturing methods.
- Explore different methods to create more accurate color reproduction for color swatches on packaging.

Data Collection Plan

The study involved conducting color accuracy tests to compare the product color (swatched onto white uncoated paper) to the swatch color on the package. Using a spectrophotometer, the color values were measured and compared. Subsequently, it was determined what percentage of lipstick shades cannot be reproduced accurately as a result of being outside the achievable printing gamut.
Procedure

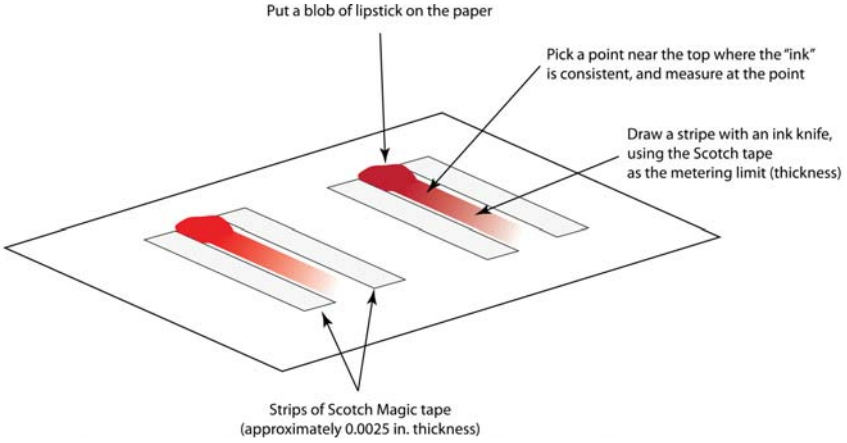
Color Accuracy Tests

I will run color tests on the products to find the differences between the advertised colors on packaging and the actual product. First, I will purchase several sample lipsticks from 3 different brands, making sure to select a range of shades for testing. Then, I will swatch each shade on paper. Next, I will measure the color value using a spectrophotometer and compare it to the color swatch printed on the packaging. I will use a spectrophotometer to test the CIE L*a*b* values of each color and then find the ΔE. Finally, I will determine which shades tend to be the most different.

Testing

Four lipsticks were purchased from three different brands (Revlon, ELF, and Rimmel). The four lipsticks included a bright red, a dark red/purple, a pink, and a tan shade in order to accurately represent the range of colors produced by each brand. The lipsticks all had matte finishes. First the CIE L*a*b* values of the labels would be measured and averaged, then the lipsticks would be swatched and measured, and then the two values would be compared and the delta E calculated for each shade of lipstick.

First, I attempted to use the spectrodensitometer to measure the CIE L*a*b* values of the colored labels while they were still on the package. This was very challenging because each label sticker has white text that includes the shade name and number as well as what type of lipstick it is, leaving only small areas of solid color. This resulted in skewed values because the densitometer was picking up white values in addition to the color being measured. To correct this, an x-acto knife was used to remove and dissect the label, cutting out the largest areas of pure color and overlapping them to create a larger area of solid color. This resulted in much more accurate and consistent readings. Each label was measured three times and the average was taken, inputting the data into a spreadsheet.

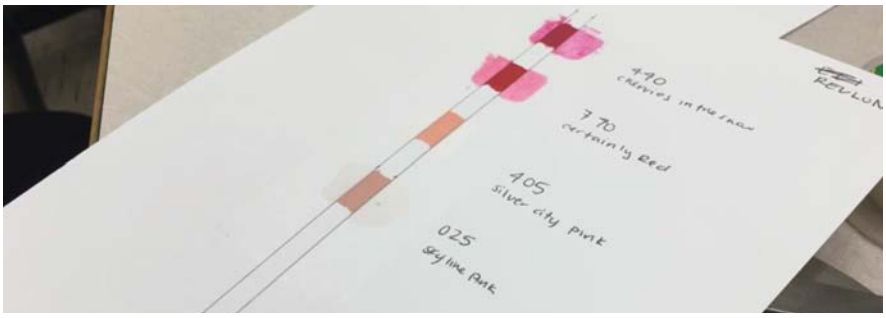


Next, the lipsticks were swatched. To ensure that the density of each swatch was even, two pieces of scotch tape were laid down on a sheet of uncoated paper ¼ inch apart, creating a channel. A dab of lipstick was then applied between the tape and dragged down using a pallet knife to create an even, smooth, consistent layer of lipstick. If the channel did not completely fill, more lipstick was applied and dragged down with the pallet knife. This process ensured that each sample had identical thickness. Then each sample was measured with the spectrodensitometer three times, the average was taken and input into the spreadsheet.

Then, using an Excel formula I found the delta E for each lipstick and its respective label. The ΔE76 formula was used, which essentially finds the distance between the two numbers.

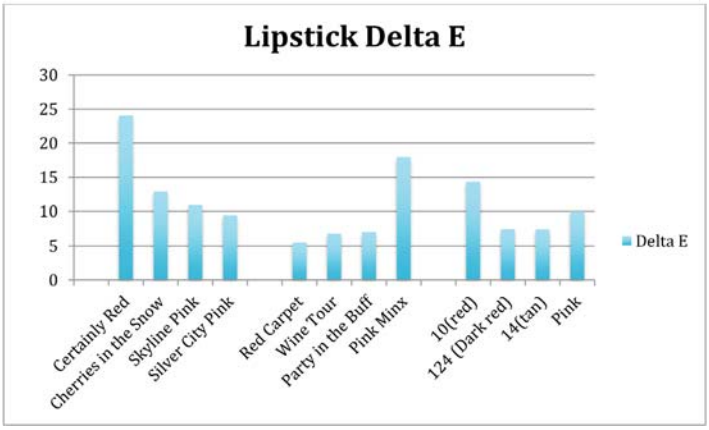
$$\Delta E^*_{ab} = \sqrt{(L^*_2 - L^*_1)^2 + (a^*_2 - a^*_1)^2 + (b^*_2 - b^*_1)^2}$$

This tends to give higher values of delta E than the other formulas, but it is the most simple to calculate.



Each lipstick was recorded in the spreadsheet, using the average function on the spectrodensitometer to record the CIE L*a*b* average of three scans. The labels were compared to the lipstick swatch, and the delta E was calculated using the 1976 formula. The lipsticks for each brand go in order of shade (red, dark red, tan, and pink).

Color/Brand	L1 (label)	L2 (Lipstick)	a1 (label)	a2 (lipstick)	b1 (label)	b2 (lipstick)	Delta E76
Revlon							*Delta E*
Certainly red	34.84	41.36	43.86	61.69	21.92	36.69	24.054
Cherries in the snow	33.02	38.59	50.66	62.01	17.74	20.28	12.896
Skyline pink	77.34	70.57	13.97	22.53	16.72	16.33	10.921
Silver city pink	74.02	75.35	33.42	32.14	14.68	23.89	9.393
ELF							*Delta E*
Red Carpet	43.8	42.75	58.58	63.84	31.25	32.53	5.514
Wine tour	28.91	29.32	31.02	26.85	5.68	0.32	6.803
Party in the Buff	63.44	62.59	28.33	34.8	20.69	23.27	7.017
Pink Minx	67.16	54.92	37.74	44.42	7.11	18.39	17.935
Rimmel							*Delta E*
10(red)	35.04	37.65	54.74	60.95	22.21	34.84	14.314
124(dark)	22.82	28.29	28.57	24.49	6.86	9.86	7.454
14(tan)	47.24	49.14	26.16	20.25	16.47	12.42	7.412
Pink	54.58	58.18	42.78	50.54	2.28	7.45	9.995

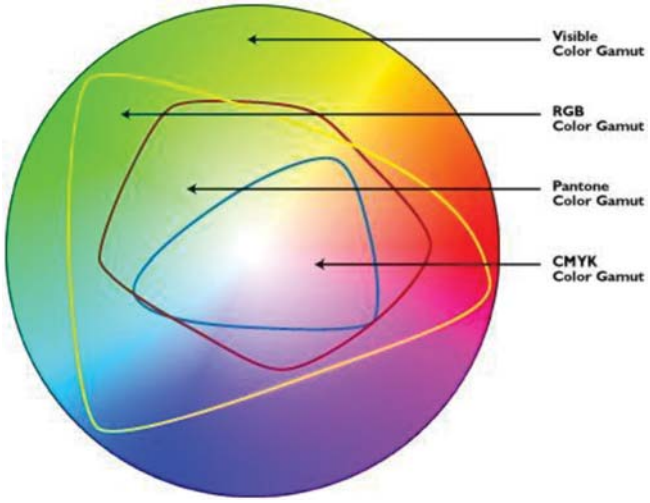


The Revlon labels appear to be printed with a spot color using offset lithography. The ELF labels appear to be printed with a spot color using flexography. The Rimmel labels appear to be printed with a spot color using gravure. Revlon had the highest average delta E of the three brands tested, with an average of 14.315. ELF had the lowest average delta E of 9.317, while Rimmel had an average delta E of 9.793. For both Revlon and Rimmel, the lipstick with the highest delta E was the red shade. This could be because it is very hard to reproduce red shades since they often fall outside of the printable gamut. The outlier for ELF was the pink shade, with a very high delta E of 17.935. Surprisingly, ELF (the cheapest brand of the three) had some of the best color reproduction, with delta E values for the other three lipsticks averaging around 6. ELF also had secondary packaging, holding the lipstick tube in a paperboard box.

The general guidelines for Delta E are as follows:

Delta E	**Perception**
≤ 1.0	Not perceptible by human eyes.
1 - 2	Perceptible through close observation.
2 - 10	Perceptible at a glance.
11 - 49	Colors are more similar than opposite
100	Colors are exact opposite

Under these guidelines, the Delta E values collected in this experiment are either perceptible at a glance or colors are more similar than opposite. It is intriguing that the colors printed on the label are so far from the actual lipstick color because it appears that all the labels were printed using a spot color, which typically provides very accurate color reproduction.



All the lipsticks tested in this experiment proved to have fairly poor color reproduction. All the colors tested showed that the color difference is easily perceptible by human eyes, which is generally unacceptable in the printing industry. It is important that label printers improve their color accuracy so customers can be more satisfied with the lipstick shade, and feel that the label accurately reflects the true shade. It would likely be effective for lipstick label printers to create a different process for printing to ensure better color accuracy. One suggestion is to use a 4-color process and adding a 5th spot color of red in order to expand the gamut of red shades that can be reproduced. Overall, doing this would allow the reds to be more vibrant and accurate to the actual lipstick.

Addendum Provided by Brian Lawler in Cooperation with the Cal Poly Chapter of TAGA Executive Board

By plotting the colors of lipstick that Ms. Burgett tested in her senior project, it shows that most are inside the GRACoL gamut. Therefore, most lipstick colors can be printed accurately on a sheet-fed press using the GRACoL standard.

However, there are a number of liptick hues that are outside the gamut of GRACoL, and very likely outside other common CMYK gamuts (FOGRA, SWOP).

The solution, we believe, is to create a 5-color ICC profile using standard GRACoL CMYK inks for the body of the color, and adding a fifth color to expand the gamut to include all the lipstick colors. This is not difficult.

We made a selection of red Pantone colors, using values provided by Pantone, and then plotted those colors compared to the measured lipstick colors in the original project. The Pantone colors selected were chosen because they are in the range of colors of these lipsticks, but they also include colors that are brighter and more saturated than any of the lipstick colors measured.

We found two Pantone colors are very close to the lipstick color that is the furthest outside the GRACoL gamut, thinking that building a profile with this color could expand the gamut on press to include the color of the "outlying" red lipstick. However, the Pantone colors selected for being the closest were closer to the axes of Lab than the lipstick colors (Delta-E values of about 4.8 and greater), meaning that the colors possibly provided by adding these are not adequate for expanding the gamut to include the lipstick colors that lie beyond GRACoL. They fall just short of making this possible, and do not expand the gamut of colors by much.

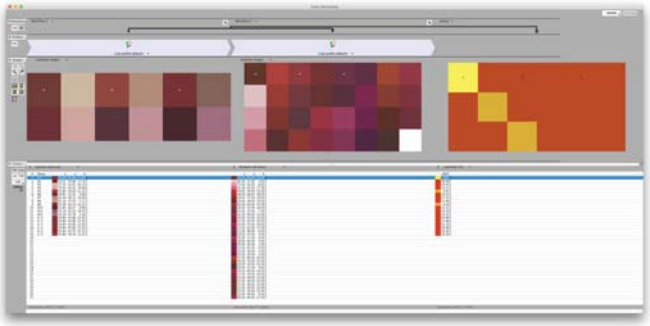
Two other Pantone colors are well outside the GRACoL gamut, and also enclose the outlying lipstick colors measured. These are Pantone 1945 and 1795. The idea of making a 5-color ICC profile using one of these colors to expand the gamut is tantalizing. Pantone colors (unless intentionally made otherwise) are opaque, making them inappropriate for any "process color" printing. So, for this expanded-gamut color profile to work, an ink formulation of a color similar to Pantone 1945 or 1795 must be made that is also transparent.

Once made, the process for making the 5-color ICC profile would be relatively straight-forward. First, measure the Lab values of the standard GRACoL inks used in the plant where the printing will occur. Second, create an ink draw-down using the standard technique for such tests, and - once dry - measure the Lab value of the expanding color of ink chosen.

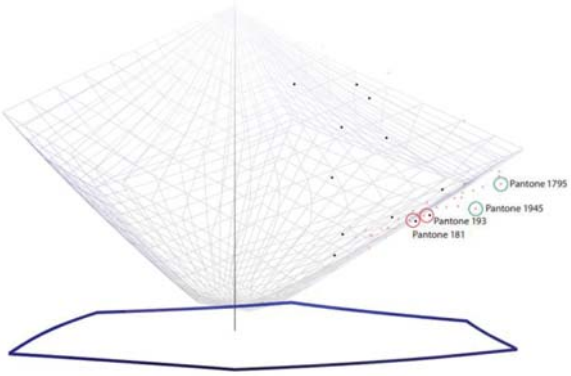
By inserting these colors into a profiling program like X-Rite's i1Profiler, along with the measured Lab values for the GRACoL inks used in the same plant, a 5-color profile can be built. Once that profile is built, it can be used to create five color separations of any cosmetics that a packaging firm might want to print that will include a significantly expanded red gamut to include many more lipstick colors than a standard CMYK gamut can print.

To be done effectively, this process should be done in two stages: one to build a test target (and then to print that target using the five colors), and the second to measure the resulting printing to build the 5-color ICC profile. This is standard procedure for such tests.

A very important consideration in any work flow using this profile would be to ensure that photos of the lipsticks or other products to be reproduced by this profile be made, and maintained throughout page layout, in RGB color using a large camera gamut (Adobe RGB would be good; ProPhoto RGB might be slightly better; sRGB would be inadequate). Converting to CMYK-Red should be done at the last stage of production, and files prepared using this work flow would almost certainly be more effective at reproducing lipstick colors that previously could not be reproduced using CMYK inks in standard gamuts.



Lab values of Pantone colors selected



Plotted Lab values

Resources:

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